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## AGROBIOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF VINE CULTIVARS CHARDONNAY AND RHEIN RIESLING IN TIKVESH WINE REGION

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### Abstract

Chardonnay and Rhein Riesling are white grape varieties that are used in producing high quality white wines. In Macedonia the production of wine grape is more than 2/3 from the whole grape production. With specific vine training we can plan the yield, make the shape and also to produce the desired quality of the wine grape. All the unnecessary shoots that are developed are removed until the start of the vegetation. The research is focused on the possibility of using different ways of pruning to achieve the best results in the yield and quality of the grape and also for introduction of machine pruning and machine harvest. The research is conducted on the wine grape varieties: Chardonnay and Rhein Riesling. On the two researched grape varieties there are 4 variants of vine training from which one is Control. For the researched variants and grape varieties, the percentage of developed shoots is calculated, potential fertility, number of clusters per vine and shoot, cluster mass per bud and variant, grape yield per vine and hectare, total sugars and total acids. Results from the research in 2016 for the grape yield per vine and per bud, yield per vine, chemical analysis for sugar content and total acids show that the best variant from the Chardonnay is Variant 3 and the Rhein Riesling is Variant 2.

**Keywords:** wine grape, Chardonnay, Rhein Riesling, vine training, yield, machine pruning, machine harvest.

### Introduction

Viticulture takes important economic part in the agriculture production in Republic of Macedonia because there are also favorable conditions for growing white grape varieties for production of high quality white wine. The white grape varieties in Macedonia take lower percentage in the whole wine production in favor of varieties for red wine production. With the knowledge of the agrobiological and technological characteristics of the white grape varieties it enables us to take advantage of the full potential that these varieties offer. Bud break, shoot development and its fertility (number of clusters per developed and fertile shoot) are important elements and characteristics of one grape variety. The different ways of pruning enables us to achieve the different results in the yield and quality of the grape whether is short spur, half long (short canes), or cane pruning. The results obtained from the different lengths in pruning will enable us to make a conclusion that will enable us to make high quality and superior quality white wines.

### Material and methods

The subject of the research are two wine grape varieties Chardonnay and Rhein Riesling purposed for production of high quality white wines. On the two researched grape varieties there are 4 variants with different vine training from which one is a Standard (Control). The Variants differentiate each other by the length of the cane. The Standard in the both Chardonnay and Rhein Riesling is with Double Guyot pruning system with two canes with 10 fertile buds and 2 spurs with 2 fertile buds with total of 24 buds per vine. In both researched vines the Variant 1 is consisted of 8 spurs with 3 buds with total 24 buds per vine. The Variant 2 is consisted of 6 long spurs with 4 buds or total of 24 buds per vine. Variant 3 is consisted of 6 long spurs with 5 buds or total of 30 buds per vine. On both grape varieties with their variants, the percentage of developed and fertile shoots is

calculated, number of clusters per shoot (relative coefficient of fertility) and number of clusters per fertile shoot (the absolute coefficient of fertility). At every grape variety and variant it's calculated the average mass of grape per bud, average mass of cluster in the researched varieties and average mass of berry for all variants. The yield that is calculated from each variant is showed as grape yield per vine and grape yield per hectare. The chemical composition of the must is showed with the contents of total sugars in g/l and the contents of total acids in g/l for every variant and grape variety. Uvologic researches are conducted by the specifications of prof, d-r Zvonimir Bozinovic (Ampelografija 2010). Total sugars are measured with Oechsle Must meter and read on Saleron - Dijardin table. The total acids are calculated by the method of the neutralisation of all acids and their salts with solution of 0,1 m - NaOH. On the base of the spent solution the quantity of total acids is calculated.

### Results and discussion

The results for the percentage of developed shoots for grape variety Chardonnay and Rheine Riesling are shown in Table 1.

Table 1. Developed shoots in percent

Variant	Variety	Chardonnay	Rheine Riesling
	bud	Developed shoots in %	
Standard	1	95,0	90,0
	2	90,0	100,0
	3	80,0	95,0
	4	85,0	95,0
	5	80,0	95,0
	6	85,0	95,0
	7	90,0	100,0
	8	85,0	100,0
	9	100,0	95,0
	10	95,0	100,0
Average		88,50	96,50
Variant 1	1	85,0	95,0
	2	100,0	100,0
	3	100,0	100,0
Average		95,0	98,33
Variant 2	1	90,0	100,0
	2	95,0	90,0
	3	100,0	100,0
	4	100,0	100,0
Average		96,25	97,50
Variant 3	1	90,0	90,0
	2	95,0	95,0
	3	85,0	95,0
	4	95,0	95,0
	5	100,0	100,0
Average		93,0	95,0

For the Chardonnay grape variety the percentages in all Variants are high with 93,00% in Variant 3, Variant 1 with 95,00% and Variant 2 with 96,25%. The results for the Rheine Riesling are higher compared with the Chardonnay with 95,00% in Variant 3, 97,50% for Variant 2 and 98,33 for Variant 1. The number of shoots per vine is important agrobiological characteristics because the shoot is carrier of the leaf and other organs of the vine (leaf, bud, tendril). The results for the fertile shoots are shown in Table 2.

The percentage varies between the Variants of the Chardonnay and it is 76,00% in Variant 3, in Variant 2 is 83,75% and the highest is in Variant 1 with 86,66%. In the Riesling variety the percentage of the fertile shoots is little higher compared with the previous variety. In Variant 3 is 88,00%, in

Variant 2 is 90,00% and in Variant 1 is 95,00% of fertile shoots. The relative coefficient of fertility (number of clusters per developed shoot) and absolute coefficient of fertility (number of clusters per fertile shoot) are shown in Table 3.

Table 2. Fertile Shoots in percent

Variant	Variety	Chardonnay	Rheine Riesling
	bud	Developed shoots in %	
Standard	1	55,0	65,0
	2	90,0	90,0
	3	85,0	85,0
	4	95,0	95,0
	5	85,0	85,0
	6	90,0	90,0
	7	90,0	90,0
	8	90,0	90,0
	9	90,0	90,0
	10	100,0	100,0
Average		87,0	88,0
Variant 1	1	75,0	85,0
	2	90,0	100,0
	3	95,0	100,0
Average		86,66	95,0
Variant 2	1	70,0	80,0
	2	80,0	85,0
	3	90,0	95,0
	4	95,0	100,0
Average		83,75	90,0
Variant 3	1	50,0	65,0
	2	65,0	90,0
	3	85,0	95,0
	4	85,0	90,0
	5	95,0	100,0
Average		76,0	88,0

The relative coefficient of fertility in the wine grape variety Chardonnay is 1,34 in Variant 3, 1,54 in Variant 2 and 1,57 in Variant 1. The relative coefficient of the fertility in the Rheine Riesling has higher values compared with the Chardonnay and its from 1,66 in Variant 2, 1,76 in Variant 3 until 2,01 in Variant 1. The absolute coefficient of fertility in the Chardonnay is varying from 1,65 in Variant 3, 1,73 in Variant 2 and 1,74 in Variant 1. In the Riesling grape variety the results are somewhat higher. The Variant 3 has 1,82, Variant 2 is with 1,87 and 2,08 clusters in Variant 1 per fertile shoot.

In Table 4 the average mass of grape per fertile bud is shown with the results shown for the Chardonnay are 295 g for Variant 3, 296 g for Variant 2 and 330 g for the Variant 1. The Riesling has shown lower results such as 268 g in Variant 2, 273 g in Variant 3 and 295 g in Variant 1. The values of the average mass of cluster of the two researched grape varieties are shown in Table 5.

The lowest value of 164 g of average mass is measured in Variant 2 in the Chardonnay, 171 g in Variant 3 and 175 g in Variant 1. Lowest values are measured in Riesling grape variety compared with the Chardonnay and are varying from 146 g in Variant 1, 153 g in Variant 3 and 157 g for Variant 2. In the table there are also indexes that are comparable with the Standard.

Table 3. Number of clusters per developed shoot and per fertile shoot

Variant	Variety	Chardonnay	Rheine Riesling	Chardonnay	Rheine Riesling
	bud	Clusters per developed shoot		Clusters per fertile shoot	
Standard	1	0,94	0,88	1,53	1,50
	2	1,55	1,00	1,72	1,46
	3	1,63	1,43	1,72	1,62
	4	1,85	1,54	2,05	1,68
	5	1,68	1,52	1,88	1,70
	6	1,84	1,49	1,94	1,73
	7	1,55	1,68	1,72	1,82
	8	1,75	1,72	1,94	1,86
	9	1,89	1,78	2,0	1,90
	10	1,95	1,88	1,95	1,96
Average		1,66	1,49	1,84	1,55
Variant 1	1	1,11	1,84	1,33	2,05
	2	1,75	2,05	1,94	2,05
	3	1,85	2,15	1,95	2,15
Average		1,57	2,01	1,74	2,08
Variant 2	1	1,24	1,16	1,50	1,69
	2	1,55	1,52	1,75	1,76
	3	1,55	2,05	1,72	1,95
	4	1,85	2,05	1,95	2,10
Average		1,54	1,69	1,73	1,87
Variant 3	1	0,88	1,16	1,50	1,16
	2	1,00	1,52	1,46	1,61
	3	1,63	2,05	1,82	2,16
	4	1,52	2,05	1,70	2,16
	5	1,70	2,05	1,79	2,05
Average		1,34	1,76	1,65	1,82

Table 4. Average mass of grape per fertile bud

Variant	Variety	Chardonnay	Rheine Riesling
	Bud	Average mass of grape per fertile bud	
Standard	1	301	247
	2	260	260
	3	238	274
	4	252	222
	5	274	250
	6	260	235
	7	236	247
	8	266	210
	9	230	240
	10	222	252
Average		254	244
Variant 1	1	333	284
	2	384	296
	3	274	306
Average		330	295
Variant 2	1	248	218
	2	272	258
	3	374	284
	4	292	310
Average		296	268
Variant 3	1	266	225
	2	338	265
	3	322	270
	4	294	289
	5	256	315
Average		295	273

Table 5. Average mass of cluster in g

Variant	Chardonnay		Rheine Riesling	
	g	index	g	index
Standard	162	100	148	100
Variant 1	175	108	146	98
Variant 2	164	101	157	106
Variant 3	171	105	153	103

Table 6. Average berry mass in g

Variant	Chardonnay		Rheine Riesling	
	g	index	g	index
Standard	1,40	100	1,17	100
Variant 1	1,52	108	1,23	105
Variant 2	1,57	112	1,24	106
Variant 3	1,47	105	1,21	103

In Table 6 the values for the average berry mass are shown for both varieties. In the Chardonnay are varying from 1,47g in Variant 3, 1,52 g for Variant 1 and 1,57 for Variant 2. The values for the Riesling are from 1,21g for Variant 3, 1,23 g for Variant 1 and 1,24 g for Variant 2. Also there are indexes for the values to be compared with the Standard.

The quantity of harvested grape is shown in Table 7.

Table 7. Harvested grape in kg

Variant	Chardonnay		Rheine Riesling	
	Kg/vine	Kg/ha	Kg/vine	Kg/ha
Standard	3,389	15.687	2,437	11.280
Variant 1	3,536	16.368	2,793	12.929
Variant 2	3,288	15.220	2,915	13.493
Variant 3	3,606	16.692	2,804	13.678

The results from the Chardonnay the quantity of harvested grape is from 3,288 kg/vine in Variant 2, 3,526 kg/vine or 16.368 kg/ha in Variant 1. The highest values of 3,606 kg/vine and 16.692 kg/ha are measured in Variant 3. The Rheine Riesling table variety has lower values and they are from 2,793 kg/vine in Variant 1, 2,804 kg/vine in Variant 3 and 2,915 kg/vine in Variant 2 or 13.493 kg/ha.

The chemical composition of the grape must with sugar content in g/l or total acids in g/l is shown in Table 8.

Table 8. Chemical composition of grape must (g/l)

Variant	Chardonnay		Rheine Riesling	
	Sugar g/l	Total acids g/l	Sugar g/l	Total acids g/l
Standard	245	5,92	216	6,45
Variant 1	248	6,15	224	6,24
Variant 2	243	6,37	210	6,80
Variant 3	221	6,75	208	6,85

The values for the sugar content in the grape must in the Chardonnay grape variety is 221 g/l for Variant 3, 243 g/l for Variant 2 and 248 g/l for Variant 1. The Rheine Riesling grape variety the values are from 208 g/l for Variant 3, 210 g/l for Variant 2 and 224 g/l for Variant 1. The total acid contents in the Chardonnay grape variety is from 6,15 g/l in Variant 1, to 6,37 g/l to Variant 2 and 6,75 in Variant 3. In the Rheine Riesling grape variety the values for the total acids are higher than the Chardonnay and are from 6,24 g/l in Variant 1, 6,80 g/l in Variant 2 and 6,85 g/l in Variant 3.

## Conclusions

From the concluded researches and the shown results we can make these conclusions:

Republic of Macedonia has beneficial conditions for successful cultivating of grape varieties that can give high quality white wine.

In the grape variety Chardonnay, the Variant 2 has the highest percentage of developed shoots of 96,25% and at the Rheine Riesling cultivar the highest values are achieved in the Variant 1 with 98,33%.

The percentage of fertile shoots in the Chardonnay is with the highest values in Variant 1 with 86,66%, or in the grape variety Riesling the highest values are recorded in the Variant 1 with 95,00 % of fertile shoots.

The relative coefficient of fertility (average number of clusters of developed shoot) at the Chardonnay is with highest value of 1,57 in Variant 1, as in the Riesling in Variant 1 with 2,01 cluster per developed shoot.

The absolute coefficient of fertility is with the highest value in Variant 1 at the Chardonnay grape variety with 1,74 clusters per fertile shoot, or 2,08 clusters in Variant 1 at the Riesling.

The average mass of grape per bud in grams in the Chardonnay grape variety is with the highest value in Variant 1 with 330 g, or 295 g in Variant 1 in the Rheine Riesling.

The average mass of cluster in g is with the highest value at Variant 1 of 175 g at the Chardonnay or 157 g in Variant 2 at the Rheine Riesling.

The value of the average mass of berry is the highest in Variant 2 at the Chardonnay grape variety with 1,57 g, or 1,24 g at the Riesling.

The quantity of harvested grape per vine is with lowest values in Variant 2 with 3,288 kg/vine, but with highest values with 3,606 kg/vine or 16.692 kg/ha at the Chardonnay, or 2,793 kg/vine at Variant 1 until 2,915 kg/vine or 13.593 kg/ha at the Rheine Riesling.

The content of sugar in grape must is with highest values in Variant 1 with 248 g/l in the Chardonnay, or 224 g/l in Variant 1 at the Riesling.

Total acids content at the Chardonnay grape variety has the highest values in Variant 3 with 6,75 g/l , or 6,85 g/l in Variant 3 at the Rheine Riesling.

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